I. INTRODUCTION

A. Coastal "Red Tides" and Toxic Estuarine Dinoflagellates

The rogue algae known as toxic dinoflagellates are considered to be photosynthetic flagellates that appear seasonally in coastal marine waters at bloom concentrations that discolor the water in hues of yellow, brown and, most commonly, red (Steidinger & Vargo 1988). A recent cosmopolitan increase in the frequency and spatial extent of red tide dinoflagellates and other toxic phytoplankton (White 1982, Steidinger & Baden 1984, Anderson *et al.* 1985, Hallegraeff 1993, Smayda 1989) suggests that these organisms may be increasingly significant in determining year class strength of estuarine and marine finfish and shellfish (Shumway 1990, Robineau *et al.* 1991). The frequency of fish ulcerative diseases and kills of unknown cause also has been on the increase worldwide (Steidinger & Baden 1984, Ryther 1989, Noga 1993).

Toxic coastal red tides generally are monospecific; these toxic dinoflagellate blooms remain in surface waters for days to months, causing finfish kills and shellfish poisoning to humans (Steidinger & Baden 1984, Anderson *et al.* 1985, White 1988, Culotta 1992). Only about 20 among more than 3,000 dinoflagellate species produce toxins (Steidinger & Baden 1984, Steidinger & Vargo 1988). The life cycles of these algae have been regarded as simplistic, alternating between flagellated cells and dormant cysts or other resting forms (Lee 1980, Steidinger & Cox 1986). The previously known toxic dinoflagellate species have all been reported in marine coastal waters at relatively high salinities ($\geq$ 20‰) and are most active during warm seasons (Steidinger & Vargo 1988). Although cultural eutrophication has been implicated in stimulating some toxic outbreaks (Paerl 1988, Smayda 1989, Hallegraeff 1993), controlled experiments to resolve the role of nutrient enrichment in promoting toxic dinoflagellate blooms have met with poor success or interpretative difficulties (Smayda 1992), partly because it has not been possible to induce excystment or lethal activity for most toxic dinoflagellates in culture (Steidinger & Baden 1984, Shimizu 1991).

Recent information has begun to alter these general concepts about toxic dinoflagellates. Firstly, a diverse assemblage of small, pigmented to colorless, cryptic flagellated and amoeboid dinoflagellates has been discovered in turbid estuaries and river systems (Mallin *et al.* 1991, Burkholder 1992). Available data suggest that these organisms, most of which have been missed or overlooked, can actually dominate the phytoplankton